
Space Weather Technical Forecast

Issued on Monday, 23 May 2022 at 01:27 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales <https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales>

Space Weather Forecast Headline: Chance of R1-R2 Radio Blackouts.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has remained Low over the past 24 hours, with the background X-ray flux measured at GOES16 remaining in low C-class with only minor isolated flares.

There are now up to nine sunspot regions on the Earth-facing side of the sun. These include the ever-present AR3014, which retained its Ekc/Beta-Gamma-Delta classification, however it showed little overall growth or changes, with no flares recorded. While on paper less potent, the rapid growth trend of nearby AR3017 (to the east) made it one to watch, although this, too, proved relatively unremarkable in the period, reaching Eai/Beta. Two new regions have recently appeared on the eastern solar horizon. The southern one, AR3020, is a unipolar and stable alpha/Hsx. The northern one, which has just been numbered as AR3021, seems to be developing but the narrow angle of view may be hampering analysis.

Coronagraph imagery revealed some notable events in the past 24 hours, for instance a large prominence lift-off on the northwest limb. However it is yet too early to establish whether a CME was associated with it as there is no available SDO imagery. No Earth-directed CMEs were observed in available imagery in the last 24 hours.

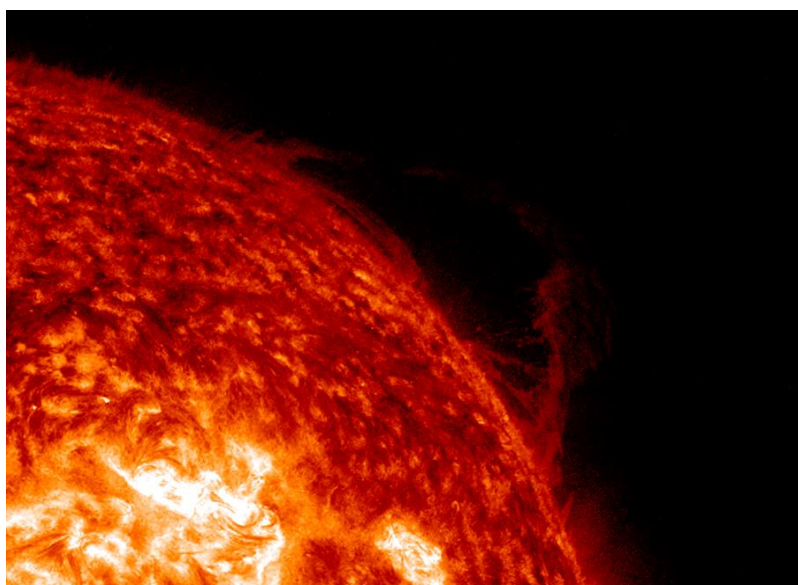


Figure 0: Helioviewer.org-generated image of AIA 304, showing a large prominence lifting off the northwest limb.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by ACE and DSCOVR at L1, has slowly but persistently increased in the last 24 hours, rising from 480 to 530 km/s, with no

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

evident reason. The solar wind density differed between the two satellites, but remained at background in single-figures ppcc. The phi angle was largely positive (away from the sun), indicating a connection with CH82/+. The IMF was level, with a peak of 6nT and a north-south variation of +4/-5nT, with long periods of negative Bz initially. The net result of the above solar wind measures was provisionally Quiet to Unsettled geomagnetic activity, with a solitary peak of Active 4 in the 00-03UTC interval.

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV) has been at Background levels through the last 24 hours.

The high energy electron flux (greater than 2 MeV) rose to Moderate levels, peaking at 953 ppcc at 22/1615UTC, as a result of the fast wind from CH82/+. Despite this the corresponding electron fluence remained well below the Active threshold (1e8 integrated pfu) with a rising then level trend to reach 2.74e7 integrated pfu at 23/0001 UTC.

Four-Day Space Weather Forecast Summary

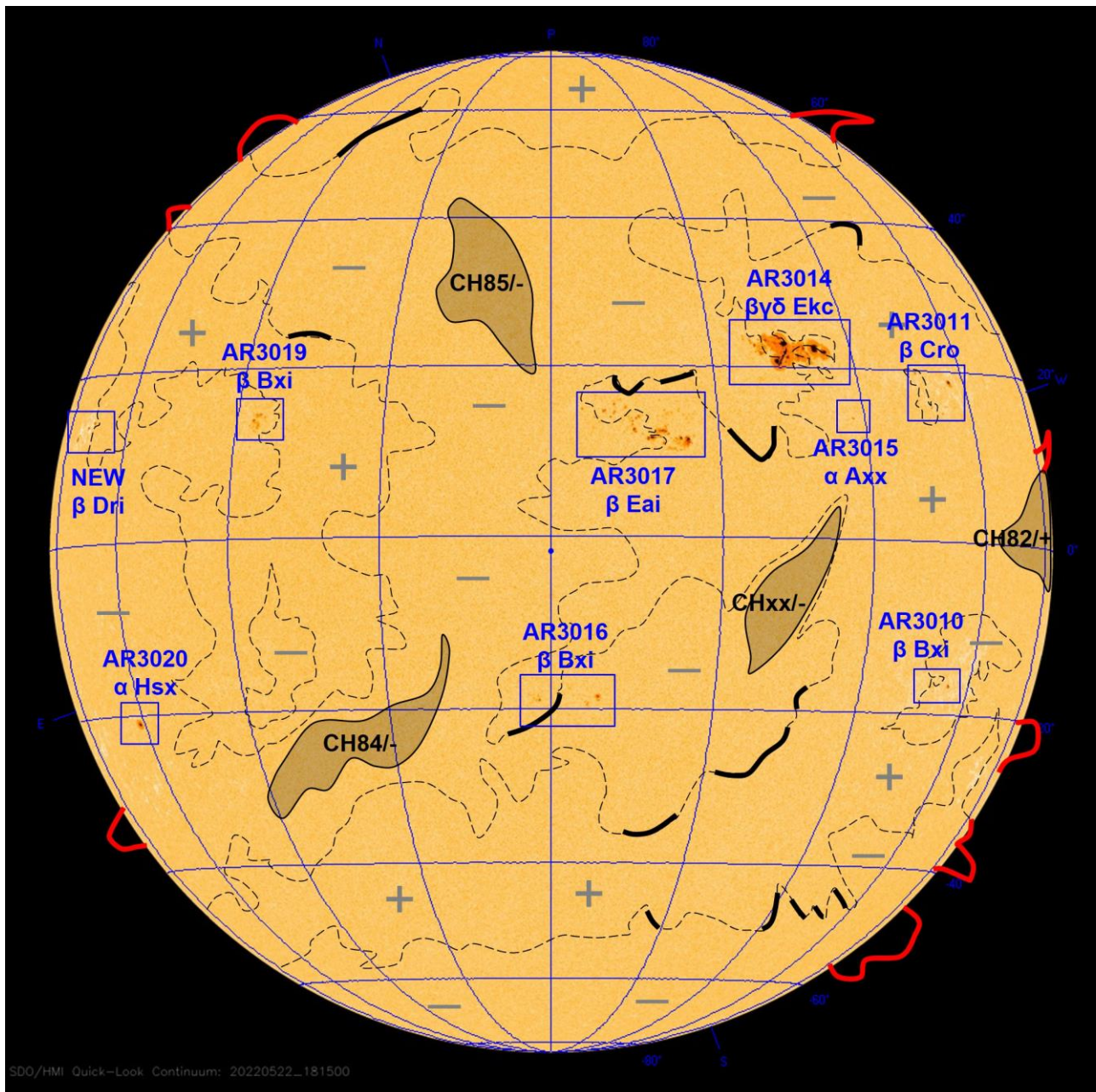
Solar Activity: Solar activity carries a daily Chance of reaching Moderate, with R1-R2 radio blackouts most likely from AR3014 but also perhaps from AR3017 given its recent growth. A bright flux area is visible on STEREO A EUVI 195 imagery, around 120 degree east, indicating the presence of one or more active regions. These will need to be closely monitored over the next few days, as they gradually emerge over the eastern limb.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs are currently expected. Solar winds are now under the waning influence of coronal hole 82 and expected to return to ambient levels over the following days. They might become slightly enhanced as a result of a possible tenuous coronal hole on Day two (Tuesday 24 May) but more likely on Day 4 (26th), under the influence of coronal hole 85, with solar winds becoming elevated. Geomagnetic activity is expected to be generally Quiet on Days 1-3 but Quiet to Unsettled with a chance of an Active interval on Day 4 (26th).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) is expected to be at Background levels during this period, but with a daily Slight Chance of flux reaching S1, should any notable flares occur.

The high energy electron flux (greater than 2 MeV) is forecast to fluctuate between Low and Moderate levels, perhaps exceeding 1000 pfu on the diurnal peak. The 24-hour electron fluence will most likely remain below the Active (1e8 integrated pfu) threshold during the forecast period, albeit with an early-week rising trend.

Figure 2. Solar Analysis Valid 22/1800 UTC.



Key: Filament ____, Prominence ____, Magnetic Field Line - - -, Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α - β - $\beta\gamma$ - $\beta\gamma\delta$ and Zurich-McIntosh Axx etc.

Geomagnetic Storms:

A few CMEs were observed on satellite imagery in the last 24 hours, but analyses have revealed that none of them are thought to be Earth-directed.

The solar wind has slowly but persistently increased in the last 24 hours whereas it should be on the decline, being on the waning influence of the fast speed stream emanating from CH82/+. There is no evident reason behind this increase and with no other significant coronal features in the western solar hemisphere, winds should decline and revert to slow-ambient levels over the following days.

A small negative coronal hole may have developed on the central western hemisphere, near the solar equator, but the proximity of EUV flux loops from two sunspot regions nearby is making the assessment difficult. However the past 2.5 days of STEREO A MAG and PLASTIC measurements do not suggest any significant departure from a slow regime going forward, and any small coronal hole here is therefore unlikely to cause any significant impacts on geomagnetic activity.

Finally, another negative, more significant coronal hole is approaching the central meridian of the Earth-facing disc, namely CH85/-. Its fast speed stream is expected to become geoeffective on Day 4 (26th), with solar wind speeds increasing towards elevated levels.

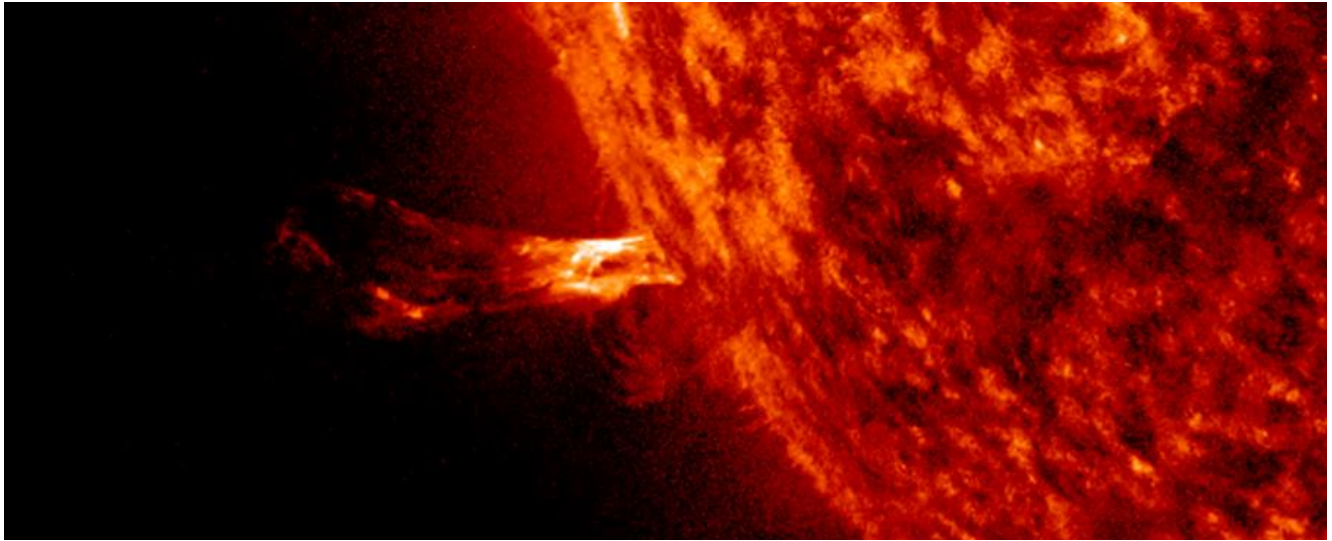
With the above in mind, geomagnetic activity is expected to be generally Quiet on Days 1-3 but Quiet to Unsettled with a chance of an Active interval on Day 4 (26th).

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	1	1	1	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

NIL

Figure 3: Helioviewer.org-generated image from AIA 304, showing an ejecta originating from a sunspot region located on the far side.



Radio Blackouts - X-Ray Flares:

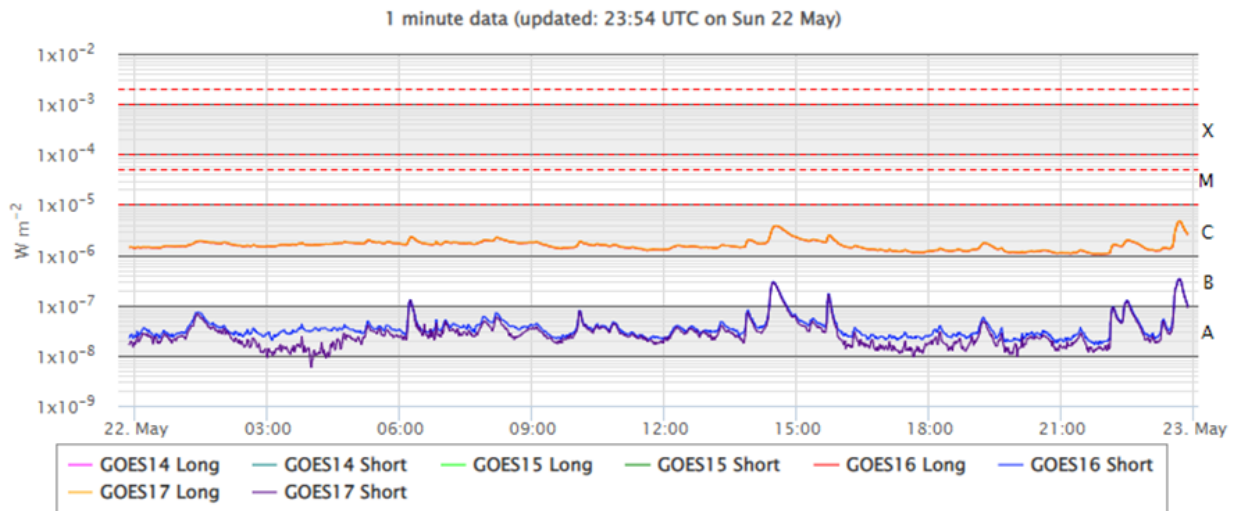
There are now up to nine sunspot regions on the Earth-facing disc. Somewhat counter to the current presentation of AR3014 and perhaps 3017, GOES16 X-ray activity has become very muted in the past 36 hours or so, probably a result of the spots' maturity, as their raw Zurich class suggests flares are much more likely than is currently being borne out. The chances of both M-class and X-class flares have both been revised slightly downwards to account for observations as a result.

AR3014 is expected to leave the disc on Thursday 26 May, and this ought to be a catalyst for a step-wise decrease in the risk of X-ray flares, even if the chances of proton storms persist a while longer onto the far side.

A bright flux area is visible on STEREO A EUVI 195 imagery, around 120 degree east, indicating the presence of one or more active regions. This was confirmed by a large CME that was seen leaving the sun on May the 21st. These will need to be closely monitored over the next few days, as they gradually emerge on to the eastern limb. A couple of large filaments also currently occupy the western solar hemisphere and any lift-off in the near-term could potentially be Earth-directed.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	40	40	40	40
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 4: Latest GOES X-Ray flux showing very low levels



Solar Radiation Storms - (High Energy Protons):

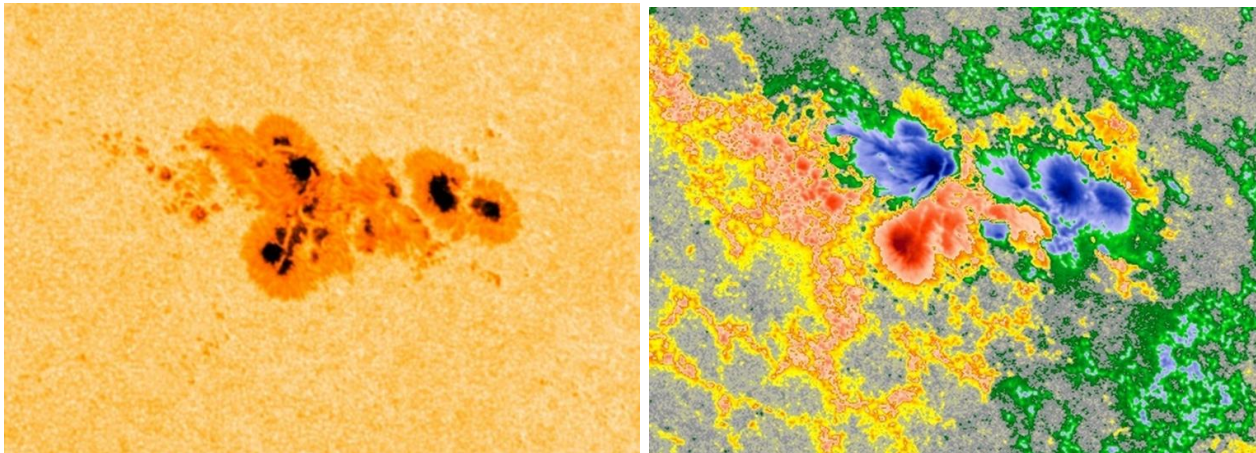
The high energy proton flux (greater than 10 MeV) is at Background levels and is most likely to remain so through the period.

The daily risk of surpassing S1 should very slightly increase over the four-day period, although the raw probability is close to 10% throughout and this figure is therefore used for all days of the period. This risk is the result of the westward progress of the largest and nominally most complex region on the disc, although despite some M-class activity, this has not yet proven to have delivered any proton enhancement at Earth.

Radiation Storms	Level ($cm^{-2} sr^{-1} s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq S1$	No	10	10	10	10
Very Active	$\geq S3$ *	No	1	1	1	1

* $S3 \geq 10 \text{ MeV} \geq 1000 \text{ pfu}$ and / or $\geq 50 \text{ MeV} \geq 10 \text{ pfu}$. (pfu = $cm^{-2} sr^{-1} s^{-1}$)

Figure 5: Latest HMI Intensitygram (left) and colorized Magnetogram (right) of the largest and most complex region, AR3014.



High Energy Electrons Event ($\geq 2\text{MeV}$):

The high energy electron flux (greater than 2 MeV) rose to Moderate levels, peaking at 953ppcc at 22/1615UTC, as a result of the fast wind from CH82/+ charging the radiation belts. It is expected to fluctuate between Low and Moderate levels over the next few days, perhaps exceeding 1000 pfu during the diurnal peak at times.

On the previous rotation, the fast solar wind regime proved incapable of resulting in Active 24-hour integrated electron fluence. The current solar wind enhancement from CH82/+ is slightly enhanced in comparison, so while flux may increasingly trouble the High boundary, on balance it should most likely average out below Active, even as geomagnetic activity from CH82 wanes into the forthcoming working week.

GEO Electron Environment	Level ($\text{cm}^{-2} \text{sr}^{-1} \text{day}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^8$	No	20	10	5	1
Very Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^9$	No	1	1	1	1

**Figure 6: Latest GOES 16 Electron Flux (top) and Met Office REFM output (bottom)**

NOTE: Our REFM model has been upgraded and has changed in appearance. The two main changes are the option to include a recurrence graph, which traces what happened on during last solar rotation for comparison and potential expectation in the coming 3 days (each plot is the observation from T-minus 28 days). Also, the cadence of REFM forecast fluence data is reduced past day 1 to only one value per day. The cadence remains 3-hourly for the first 24 hours.